POL -T- 3

Table 3 Existing Data on Nonpoint Sources Measures

Table 3.1 Agricultural Area

Table 3.2 Urban Area

Table 3.1-1 Relative Gross Effectiveness [a] of Sediment [b] Control Measures

(Pennsylvania State University, 1992a)

Practice Category[c]	Runoff[d] Volume	Total[e] Phosphorus (%)	Total[e] Nitrogen (%)	Sediment (%)
Reduced Tillage Systems[f]	—	45	55	75
Diversion Systems[g]	—	30	10	35
Terrace Systems[h]	—	70	20	85
Filter Strips[i]	—	75	70	65

[a] Actual effectiveness depends on site-specific conditions. Values are not cumulative between practice categories.
[b] Includes data where land application of manure has occurred.
[c] Each category includes several specific types of practices.
[d] – indicates reduction; + increase; 0 no change in surface runoff.
[e] Total phosphorus includes total and dissolved phosphorus; total nitrogen includes organic-N, ammonia-N, and nitrate-N.
[f] Includes practices such as conservation tillage, no-till, and crop residue use.
[g] Includes practices such as grassed waterways and grade stabilization structures.
[h] Includes several types of terraces with safe outlet structures where appropriate.
[i] Includes all practices that reduce contaminant losses using vegetative control methods.

Table 3.1-2 Relative Gross Effectiveness [a] of Confined Livestock Measures

(Pennsylvania State University, 1992a)

Practice[b] Category	Runoff[c] Volume	Total[d] Phosphorus (%)	Total[d] Nitrogen (%)	Sediment (%)	Fecal Coliform (%)
Animal Waste Systems[e]	—	90	80	60	85
Diversion Systems[f]	—	70	45	NA	NA
Filter Strips[g]	—	85	NA	60	55
Terrace System	—	85	55	80	NA
Containment Structures[h]	—	60	65	70	90

NA = not available.
[a] Actual effectiveness depends on site-specific conditions. Values are not cumulative between practice categories.
[b] Each category includes several specific types of practices.
[c] – = reduction; + = increase; 0 = no change in surface runoff.
[d] Total phosphorus includes total and dissolved phosphorus; total nitrogen includes organic-N, ammonia-N, and nitrate-N.
[e] Includes methods for collecting, storing, and disposing of runoff and process-generated wastewater.
[f] Specific practices include diversion of uncontaminated water from confinement facilities.
[g] Includes all practices that reduce contaminant losses using vegetative control measures.
[h] Includes such practices as waste storage ponds, waste storage structures, waste treatment lagoons.

Table 3.1-3 Relative Effectiveness a of Nutrient Measures

(Pennsylvania State University, 1992a)

Practice	Percent Change in Total Phosphorus Loads	Percent Change in Total Nitrogen Loads
Nutrient Management[b]	-35	-15

[a] Most observations from reported computer modeling studies.
[b] An agronomic practice related to source management; actual change in contaminant load to surface and ground water is highly variable.

Table 3.1-4 Sediment Reduction by Grass Riparian Buffers

a) Sediment Reduction by Grass Riparian Buffers on a Piedmont Site

Grass Buffer Width	Plot	% Reduction
14 ft	1	71
14 ft	2	68
28 ft	1	90
28 ft	2	86

b) Sediment Reduction by Grass Riparian Buffers on a Coastal Area

Grass Buffer Width	Plot	% Reduction
14 ft	1	70
14 ft	2	83
28 ft	1	82
28 ft	2	90

Grass riparian buffers in combination with forested areas appear to do the best job of reducing both sediment and phosphorus, as can be seen from the following table. The effects of different riparian buffer widths in reducing sediment, nitrogen, and phosphorus are presented in Table **c)**.

c) Effects of Different Size Riparian Buffers on Reduction Sediment and nutrients from field Surface Runoff (from Lowrance et. Al., 1995)

		Sediment			Nitrogen			Phosphorus		
Buffer Width	Buffer Type	Input Conc.	Output Conc.	Reduction	Input Conc.	Output Conc.	Reduction	Input Conc.	Output Conc.	Reduction
m		--mg L--		%	--mg L--					
4.6[1]	Grass	7284	2841	61.0	14.11	13.55	4.0	11.30	8.09	28.5
9.2[1]	Grass	7284	1852	74.6	14.11	10.91	22.7	11.30	8.56	24.2
19.0[2,3]	Forest	6480	661	89.9	27.59	7.08	74.3	5.03	1.51	70.0
23.6[5]	Grass/ Forest	7284	290	96.0	14.11	3.48	75.3	11.30	2.43	78.5
28.2[6]	Grass/ Forest	7284	188	97.4	14.11	2.80	80.1	11.30	2.57	77.2

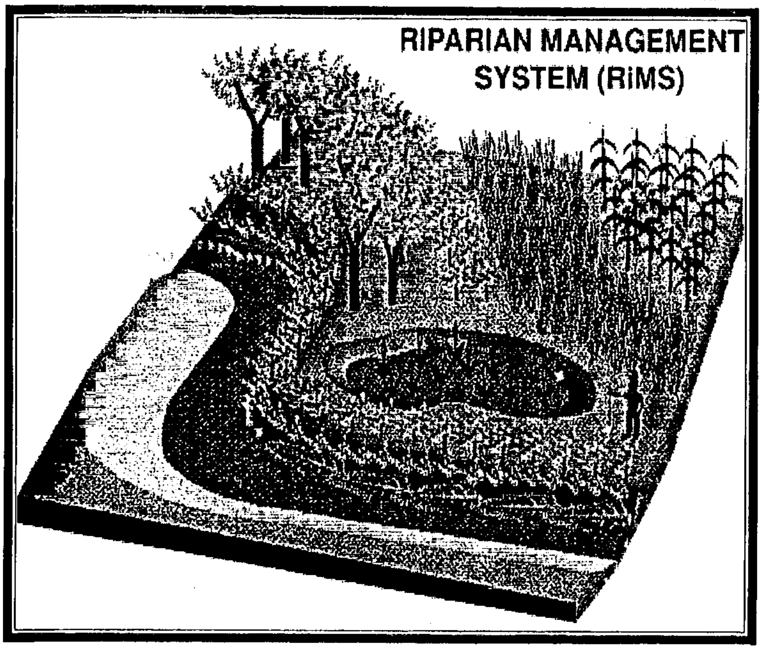
[1]Calculated from masses of total suspended solids, total N, total P, runoff depth, and plot size (22 x 5 m) from Magette et al. (1989)
[2]Input concentrations from Table 2, Peterjohn & Correll (1984). Nitrogen = Nitrate-N + exch. part. ammonium + diss. ammonium + part. organic N + diss. organic N. Phosphorus = part. P + diss. P.
[3]Surface runoff concentrations at 19 m into forest reported by Peterjohn & Correll (1984). N and P constituents same as input (footnote 2).
[4]Percent reduction = 100 * (Input-Output)/Input.
[5]4.6 m grass buffer plus 19 m of forest.
[6]9.2 m grass buffer plus 19 m of forest.
conc. = concentration.

Table 3.1-5 Effectiveness of Vegetated Filter Strips for Pollutant Removal

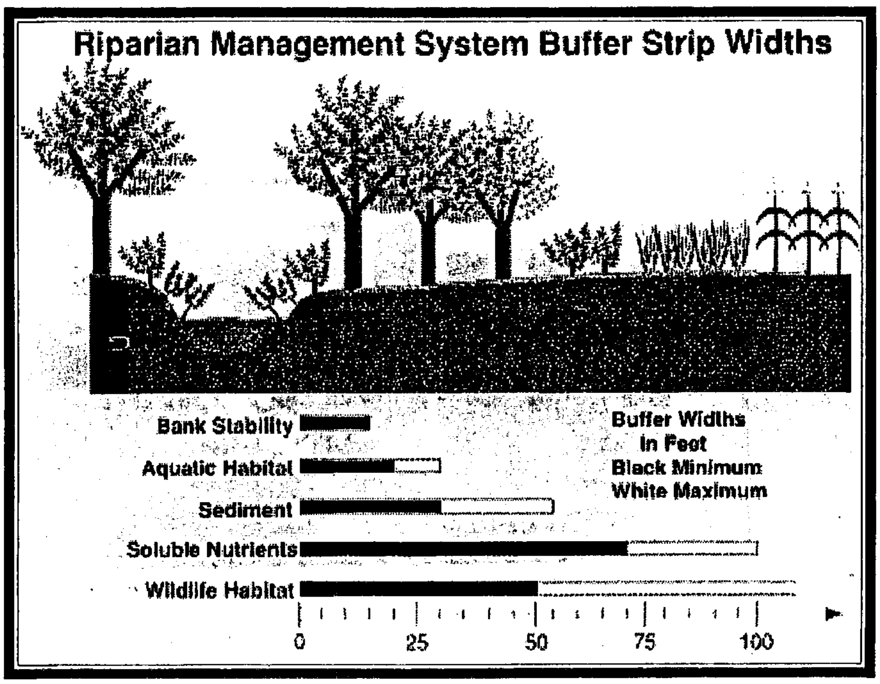
The system objective is to restore such original riparian zone functions as: 1) intercepting eroding soil and chemicals from crop fields; 2) improving subsurface water quality from crop fields; 3) reducing streambank erosion; 4) slowing flood waters; 5) improving aquatic habitat; 6) providing wildlife habitat; and 7) providing alternative crops.

1.Multi-species Buffer Strip

Three zones: 1) tree zone nearest the streambank to quickly stabilize the bank, sequester chemicals, and improve aquatic habitat;2) shrub zone to provide woody roots, multiple stems and biodiversity;3) native prairie grasses to intercept and disperse surface runoff and provide rapidly cycling organic matter for microbial processes.

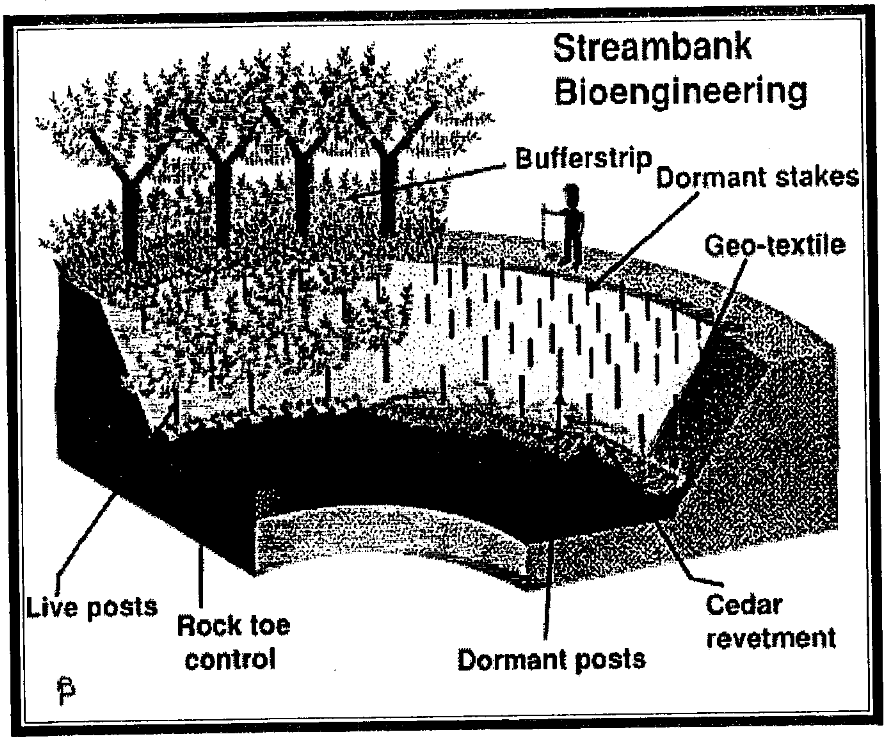


Model of a Riparian Management System

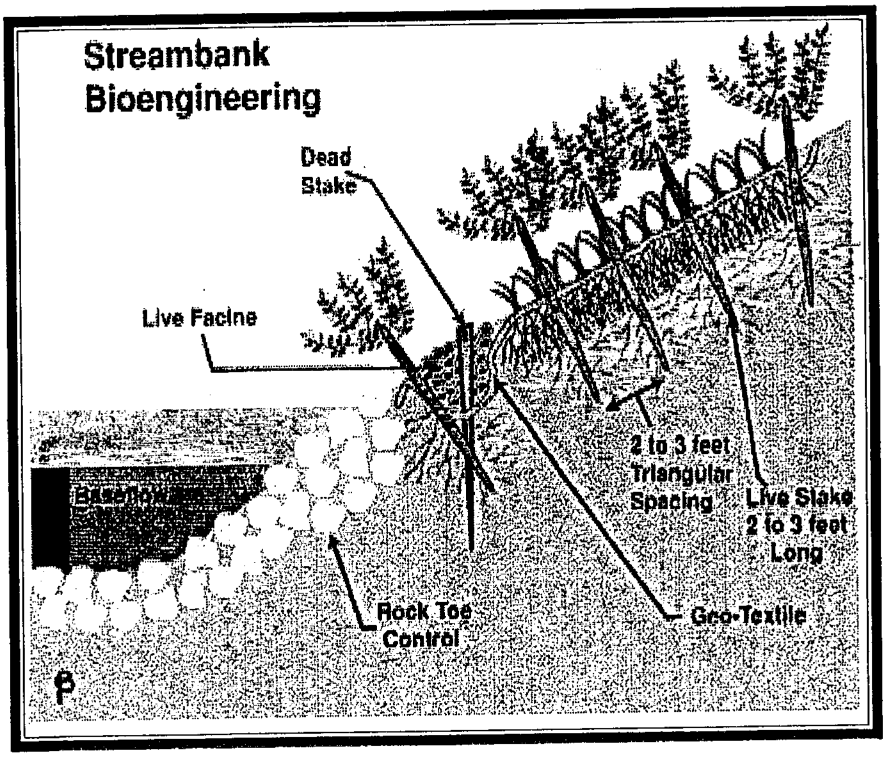


2.Streambank stabilization

Streambank bioengineering can reduce erosion which can be responsible for more than 50% of the stream sediment load. Systems vary from the simple use of willow posts with Eastern red cedar for bank toe control to more complex and expensive systems using geotextiles with rock for toe control.



Model of RiMS with streambank stabilization structures.



Streambank stabilization using bioengineering techniques

Table 3.1-6 Effectiveness of Controlled Drainage

Controlled Drainage

Water control structures, such as a flashboard riser, installed in the drainage outlet allow the water in the drainage outlet to be raised or lowered as needed. This water management practice has become known as controlled drainage. When the flashboards are lowered or removed, subsurface drainage occurs more quickly (Figure 7a and 7b). When flashboards are added to the riser, the subsurface drainage rate is decreased and the height of the water level in the ditches and surrounding fields rises. Managing the field water through the use of controlled drainage allows timely drainage but also maximum storage of water within the field for utilization by the crop.

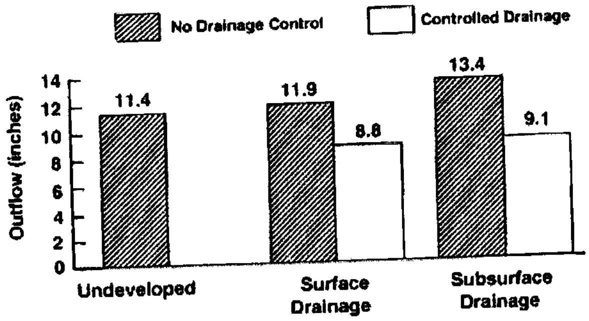


Figure 8a. Average annual outflows measured from 14 sites in eastern North Carolina. The values shown represent approximately 125 site-years of data (from Evans et al., 1991).

Controlled Drainage

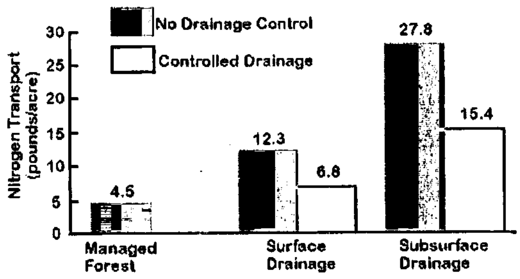


Figure 8b. Average annual nitrogen transport (TKN and NO3-N) in drainage outflow as measured at the field edge for 14 soils and sites (from Evans et al., 1991).

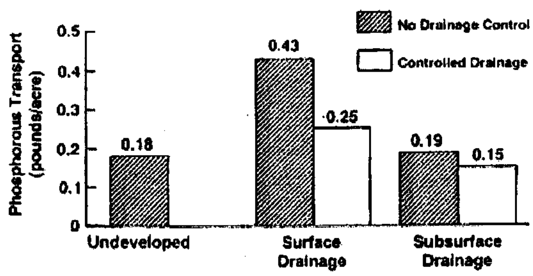


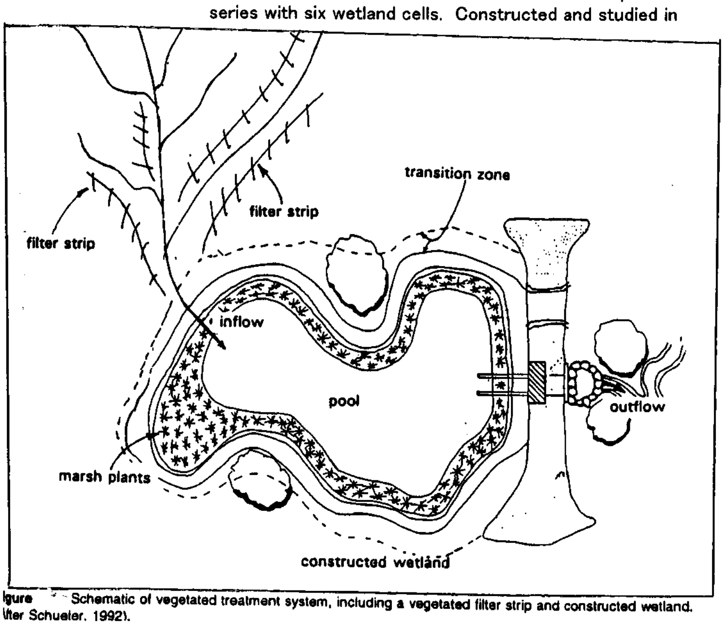
Figure 8c. Average annual total phosphorus transport in drainage outflow as measured at the field edge for 12 soils and sites. Values

Table3.2-1 Effectiveness of Constructed Wetlands for Treatment of Surface Water Runoff

Constituent	Lake Jackson (%)	Orange Country (%)	Tampa Office (%)	MWTS (%)
Total				
Solids				
Suspended	94	83	63	90
Organic	96			
Nitrogen				
Total	76	30	10	50
Ammonia	37	32	34	
Nitrate	70		75	56
Nitrite	75			
Organic(TKN)		34	-8	48
Phosphorus				
Total	90	37	54	55
Ortho	78	21	63	33
Metals				
Lead		81		75
Iron			33	
Nickel			21	

Sources: Lake Jackson: Touvila et al. 1987. An evaluation of the Lake Jackson (Florida) Filter System and Artificial Marsh on Nutrient and Particulate Removal from Stormwater Runoff.
Orange Country: Martin and Smoot. Undated. Tampa Office Wet Detention Stormwater Treatment.
Tampa Office: Rushton and Dye 1990. Water Quality Effectiveness of a Detention/Wetland Treatment System and Its Effect on an Urban Lake.
MWTS: Oberts and Osgood 1991. Constituent Load Changes in Urban Stormwater Runoff Through a Detention Pond-Wetland System in Central Florida.

Notes: Lake Jackson: Constructed wetland system located in Tallahassee, FL. Consists of a detention pond in series with a sand filter and constructed wetland. Analysis done in 1985.
Orange Country: Wetland and detention pond system in Orlando, FL. Constructed in 1980.
Tampa Office: Constructed detention pond and wetland system located in Tampa, FL. Analysis done in 1989.
MWTS: Constructed detention pond and wetland system located in Roseville, MN. Consists of a detention pond in series with six wetland cells. Constructed and studied in



lgure Schematic of vegetated treatment system, including a vegetated filter strip and constructed wetland.
lter Schueler, 1992).

Table 3.2-2 Effectiveness of Stormwater Management Practices

Practice-Characteristics	Pollutants Controlled	Removal Efficiencies (%)	Use with Other Practices	Cost	Retrofit Suitability	References	Pretreatment of Runoff
Sand Filter	TSS	60-90	Yes	$1-11 per ft^3 of runoff	Medium	City of Austin, 1990; Schuleler 1991; Tull 1990	Yes
	TP	0-80					
	TN	20-40					
	Fecal Col	40					
	Metals	40-80					
Wet Pond	TSS	50-90	Yes	$349-823 per acre treated; 3-5 of capital cost per year	Medium	Schueler, 1987 1991; USEPA, 1986	Yes, but not necessary
	TP	20-90					
	TN	10-90					
	COD	10-90					
	Pb	10-95					
	Zn	20-95					
	Cu	38-90					
Constructed Wetlands	TSS	50-90	Yes	See Chapter 7	Medium		Yes
	TP	0-80					
	SP	30-65					
	TN	0-40					
	NO_3	5-95					
	COD	20-80					
	Pb	30-95					
	Zn	30-80					

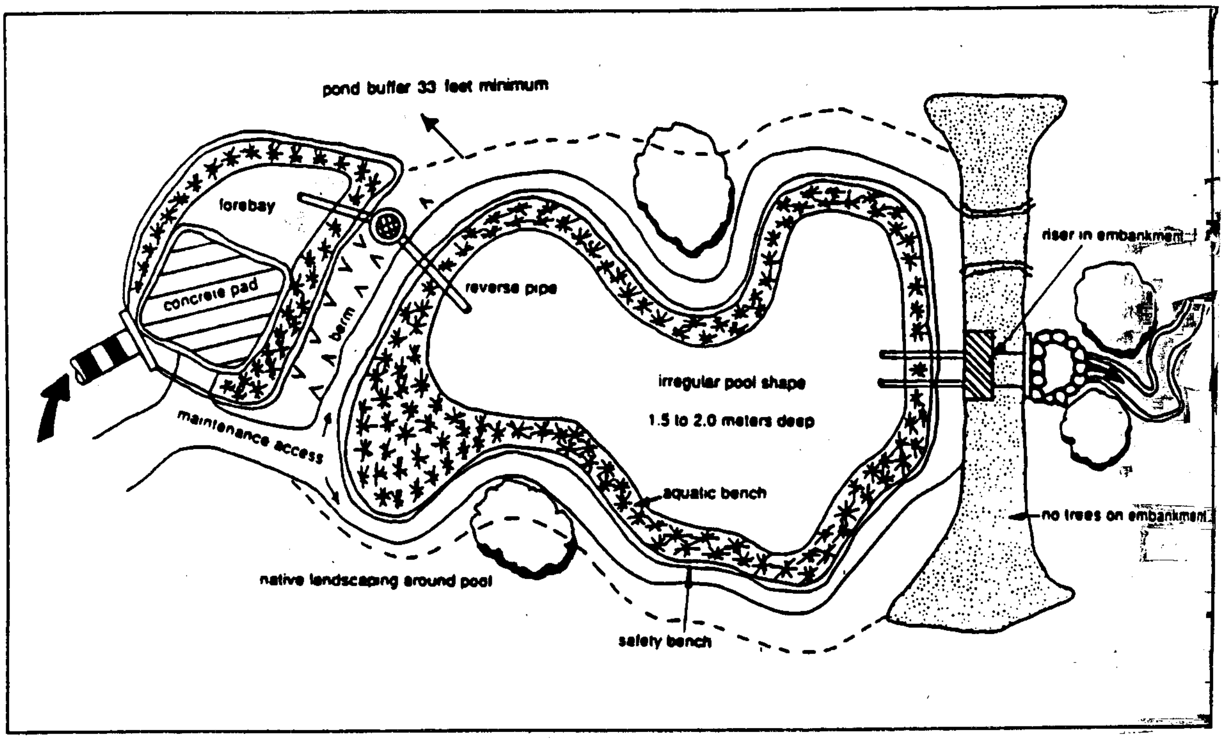
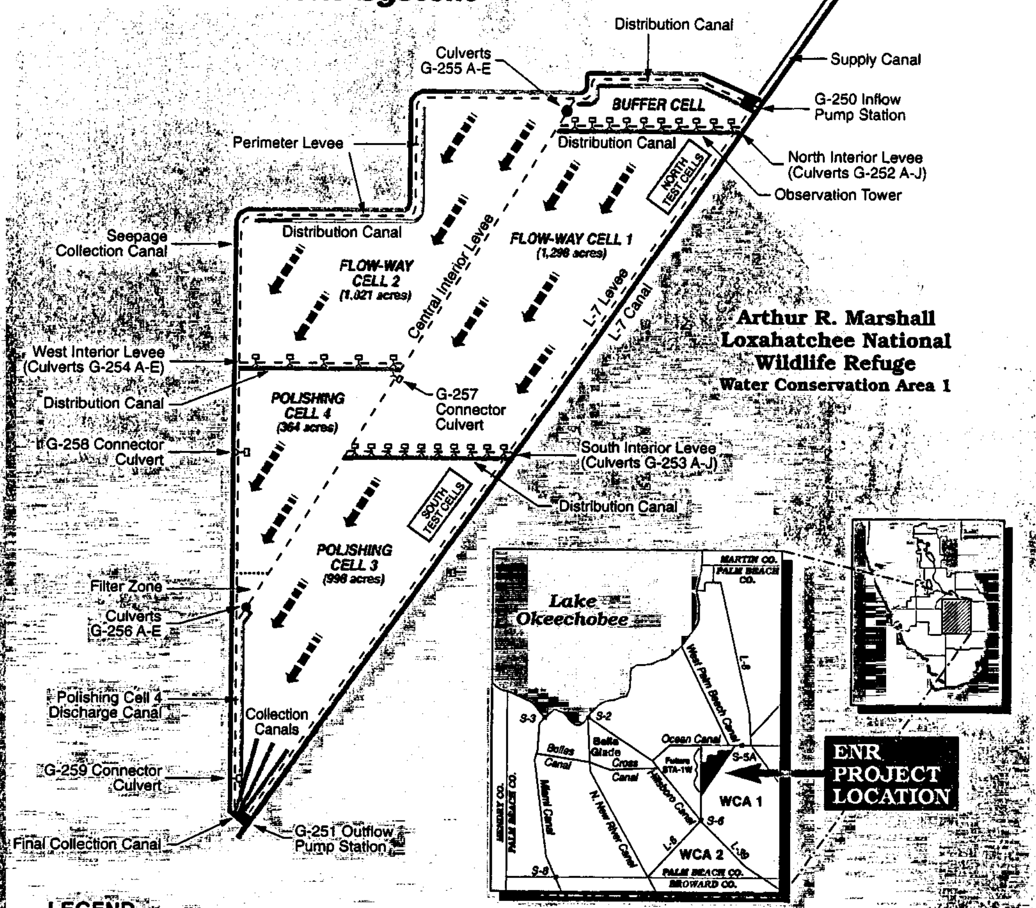


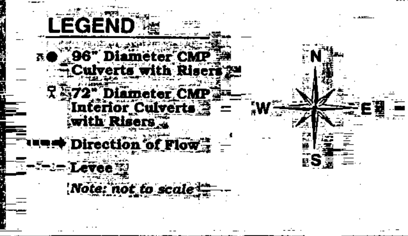
Figure Schematic design of an enhanced wet pond system (Schueler, 1991).

Table 3.2-3 Effectiveness of Wetland Treatment System

Everglades Nutrient Removal Project

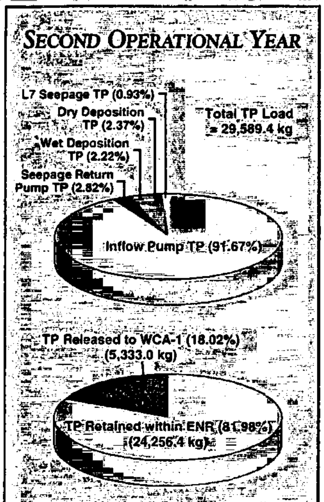
PROTOTYPE STORMWATER TREATMENT AREA (STA) *Wetland Treatment System*

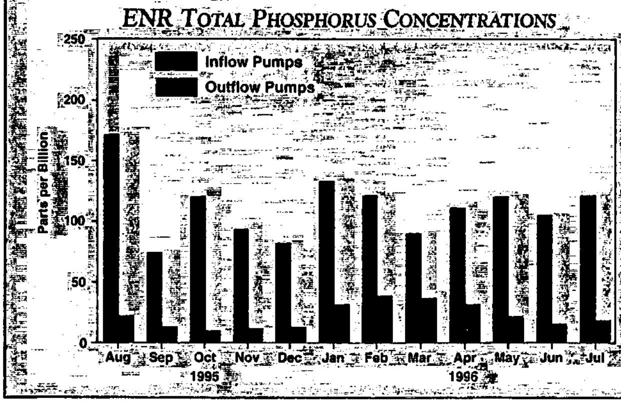




FIRST 24 MONTHS OF OPERATION:

- **303,000 acre feet of water treated**
- **86,000 pounds of phosphorus removed**
- **116 ppb average phosphorus concentration at inflow**
- **23 ppb average phosphorus concentration at outflow**





▲ *Monthly flow-weighted mean concentrations of total phosphorus at the ENR Project.*

◀ *Contributions from different inflow sources to the total phosphorus load to the ENR Project and proportion of that load released to WCA-1.*

Table 3.2-4 Effectiveness of Elimination of Garbage Disposals

Parameter	Reduction in Pollutant Loading (%)
Suspended Solids	25-40
Biohemical Oxygen Demand	20-28
Total Nitrogen	3.6
Total Phosphorus	1.7